

The TAU Performance System

The TAU project at the University of Oregon are delivering robust technologies for the performance and program analysis of HPC systems and software of importance to the Department of Energy. In particular, the DOE's Advanced Simulation and Computing Initiative (ASCI) demands performance tools that are portable across the range of ASCI computer systems and programming environments, and can operate at large scale in both parallelism and application size. The goal of the TAU project is to assist ASCI software developers and application researcher in understanding the performance of their codes and optimizing them to exploit the full power of ASCI machines.

TAU Performance System

The TAU performance system is a robust performance instrumentation, measurement, analysis, and visualization toolkit for scalable HPC systems and software. TAU is a highly portable and integrated performance system, supporting all DOE HPC platforms and all dominant programming languages, compilers, thread libraries, and communications libraries used for HPC software development. In addition, TAU incorporates other important performance technologies, giving it the most versatility of any performance system available. The current status of the TAU performance system is shown below:

- **Platforms:** IBM SP / Power4, SGI Origin 2K/3K, HP (Compaq) SC (Tru64), HP Superdome/V-class (HP-UX), Cray T3E / SV-1 (X-1 planned), Sun, Hitachi SR8000, NEC

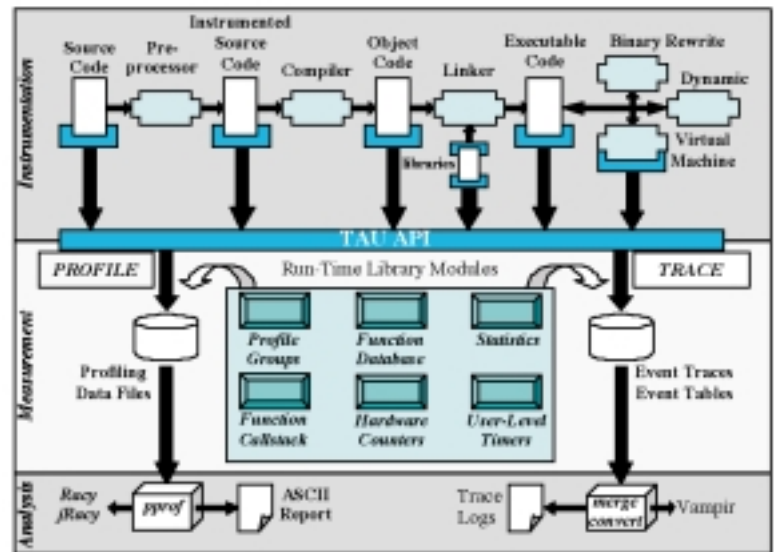
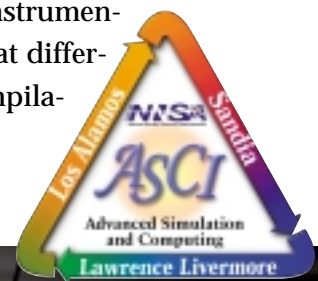


Figure 1 TAU Performance System

SX-5 / 6 (underway), Linux cluster (IA-32/64, Alpha, PPC, PA-RISC, Power), Apple (Mac OS X), Windows

- **Languages:** C, C++, Fortran 77, F90, OpenMP, HPF, Java, Python
- **Thread libraries:** pthreads, SGI sproc, OpenMP, Java, Windows
- **Communications libraries:** MPI, PVM, Nexus, SHMEM, MPIJava
- **Parallelism paradigms:** shared memory multi-threading, distributed memory message passing, mixed-mode (e.g., OpenMP and MPI)
- **Performance technologies:** Dyninst dynamic instrumentation, PAPI and PCL hardware counter libraries, Opari automatic OpenMP instrumentation, EPILOG tracing library, EXPERT trace analyzer, Vampir trace visualization, Paraver trace visualization

TAU supports a flexible instrumentation model that applies at different stages of program compilation and execution. The



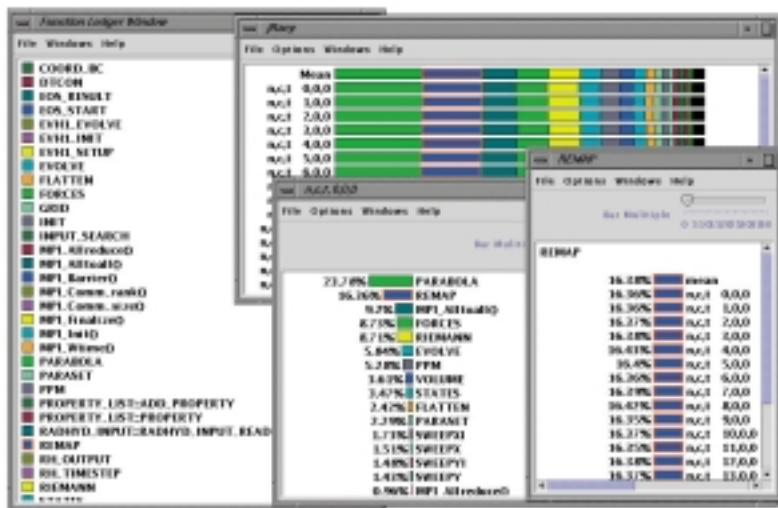


Figure 2. Enhanced Virginia Hydrodynamics #1 (EVH1) - Profile

instrumentation targets multiple code points, provides for mapping of low-level execution events to higher-level performance abstractions, and works with multi-threaded and message passing parallel computation models. Automatic source instrumentation for C, C++, F77, and F90 languages is implemented using the Program Database Toolkit (PDT). Instrumentation code makes calls to the TAU measurement API. The TAU measurement library implements performance profiling and tracing for performance events occurring at function, method, basic block, and statement levels during execution. Performance experiments can be composed from different measurement modules, including hardware performance monitors, and measurements can be collected with respect to user-defined performance groups. The TAU data analysis and presentation utilities offer text-based and graphical tools to visualize the performance data as well as bridges to third-party software, such as Vampir for sophisticated trace analysis and visualization.

TAU Application

TAU is being applied in a wide range of DOE projects with diverse performance analysis needs. In many cases, TAU is the only performance system that can solve the instrumentation and measurement problems encountered. The following lists TAU's application in some current DOE projects:



Figure 3. Enhanced Virginia Hydrodynamics #1 (EVH1) - Trace

- **C-SAFE** (ASCI/ASAP; University of Utah)
- **VTF** (ASCI/ASAP; Caltech)
- **OpenMP** (ASCI Path Forward; Intel/KAI, Pallas)
- **SAGE** (LANL)
- **Kull , SAMRAI, Overture** (LLNL)
- **PERC** (DOE SciDAC; PERC consortium)
- **PETSc** (ANL)

Project URL:

<http://www.cs.uoregon.edu/research/paracomp/tau>

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